

SMW for Context Management in a Web of Things Use Case of Ambient Assisted Living

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„Take home“ message

Semantic MediaWiki as well as **Web of Things** approaches can be a tool for **describing and adjusting an AAL environment –also for non experts- in an easy way** to the needs of elderly and impaired people to give them the possibility to live a self-determined and independent life.

What is Ambient Assisted Living?

- **Methodologies**
- **Approaches**
- **Services** to assist elderly and impaired people
- **Human resources**
- Integrated **Sensors** and **Actors**.

Goal: Elderly and impaired people shall live and participate an independent, self-determined and social active life.



An example: The AICASys project

- A national project
- Duration: 01.03.2015 – 28.02.2018
- Project partners: University of Heidelberg, German Research Center for artificial intelligence, Cibek Home Automation, SMI Sensor Motor Instruments
- Goal:

Supporting impaired people to live an self-determined and independent life in their living environment. The target group shall be supported with an Eye Tracking Glass and an autonomous wheelchair. The Eye Tracking Glass detects according to the gazes of the end user the objects of interest. According to this and further context information the intention of the user is determined.



A characteristic AAL environment in AICASys



Source: University Heidelberg

Motivation and problems

- **Complex environments:** AAL consists of complex environments with different **Things of Interest**.
- **No Interoperability:** Different devices with different protocols participating an AAL environment.
- **No Standardization:** Proprietary protocols. No universal standards.
- **Developer unfriendly:** Different devices and standards require different implementations.
- **Komplex integration** of devices.
- **Komplex configuration** to personal aspects and needs.
- **User unfriendly** usage. Experts are needed.

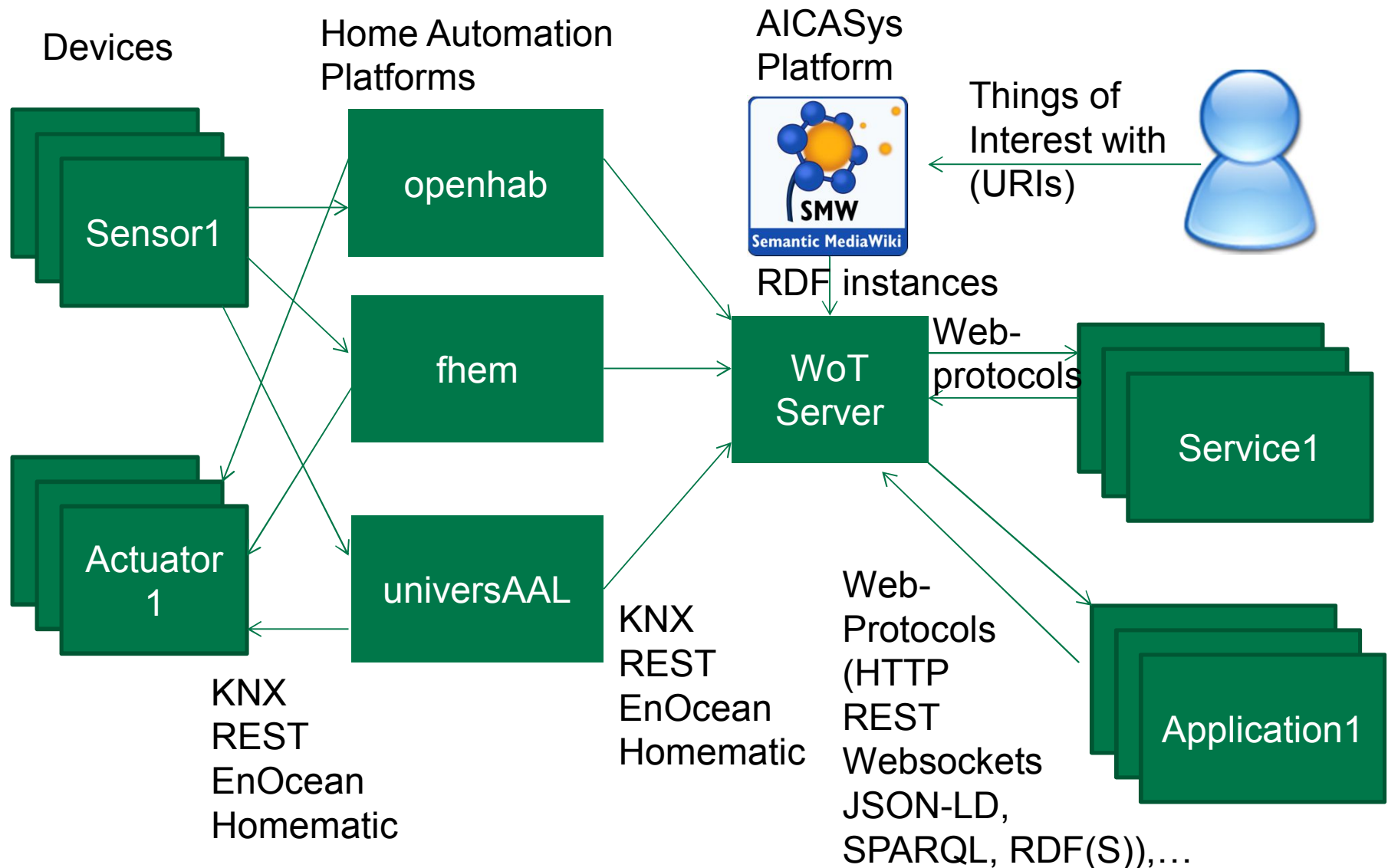
Challenges to solve

- **Representation** of Things of interest in the AAL domain.
- **Management** of the **semantic** of these things.
- **Management** of the **interaction** between these things.
- The **linking** of things of interest to each other.
- Handling of **property** and **value changes**.
- **Integration** of new objects into an AAL space.
- Warranty of **security** and **privacy** aspects?
- Warranty of **performance**?

Approach: Web of Things

- **Things** can be everything **of interest** in the domain (e.g. persons, devices, services, events...)
- Things are unique through **URIs**
- Interaction of things through known **Web protocols** (REST, HTTP, Websockets...)
- Different **communication patterns** like: Publisher-Subscriber, Push-Pull, Peer-to-Peer, Client-Server...
- Description of things in **machine-interpretable** dimensions like: RDF(S), OWL, JSON-LD, Turtle, SPARQL, N-Triple,...
- Describing things by:
 - **events** generated by a thing
 - **properties** describing a thing
 - **actions** invoked on a thing
- **Linking** of things

Technical Perspective: Web of Things



AAL Domain Classes (Things of Interest)

- **Wearable and stationary devices** for measuring or monitoring the activities of the impaired person.
- **User Profiles** describing the impairments and diseases of the assisted person.
- **Location and living environment** of the assisted person.
- **Involved People** like (caregiver, relatives, friends, neighbours...).
- **Services** providing assistance to for different use cases.

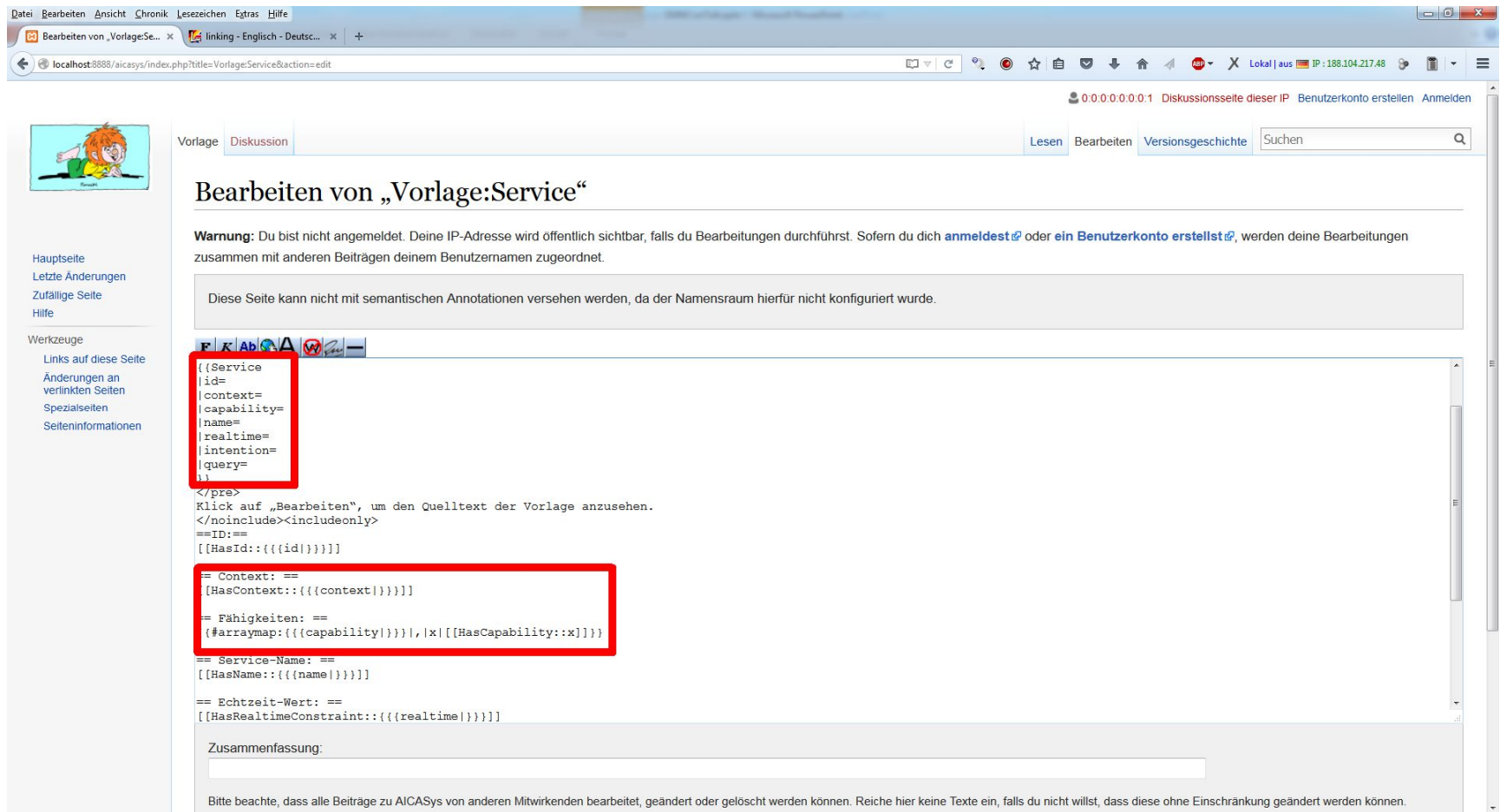
What can SMW do here?

Approach: Mapping of Things to SMW

Real World	SMW	Syntax
Definition of Things	Classes, Categories	[[Category:Wearable]]
Features of Things	Properties, Annotations	[[HasColor::red]]
A unique Thing (Lamp1)	Page:Lamp1	Wiki-Base URI + Page-ID = URI
Relation to other things	Page Links	[[Property::Value]]
Taxonomy	Sub-categories	
Characteristics	Datatypes (Page, Text, URI, Mail, Number...)	[[Datatype::Text]]

Important: SMW just can provide static data which is not changing during runtime!

Approach: Templates for annotating and defining things



The screenshot shows a web browser window with the address bar displaying 'localhost:8888/aicasys/index.php?title=Vorlage:Service&action=edit'. The page title is 'Bearbeiten von „Vorlage:Service“'. The page content includes a warning message: 'Warnung: Du bist nicht angemeldet. Deine IP-Adresse wird öffentlich sichtbar, falls du Bearbeitungen durchführst. Sofern du dich [anmeldest](#) oder ein [Benutzerkonto erstellst](#), werden deine Bearbeitungen zusammen mit anderen Beiträgen deinem Benutzernamen zugeordnet.' Below the warning, there is a message: 'Diese Seite kann nicht mit semantischen Annotationen versehen werden, da der Namensraum hierfür nicht konfiguriert wurde.' The main editing area contains a code editor with the following content:

```
<{{Service
|id=
|context=
|capability=
|name=
|realtime=
|intention=
|query=
}}
</pre>
Klick auf „Bearbeiten“, um den Quelltext der Vorlage anzusehen.
</noinclude><includeonly>
==ID==
[[HasId::{{{id}}}}]

== Context: ==
[[HasContext::{{{context}}}}]

== Fähigkeiten: ==
{{#arraymap:{{{capability}}}|,|x|[[HasCapability::x]]}}

== Service-Name: ==
[[HasName::{{{name}}}}]

== Echtzeit-Wert: ==
[[HasRealtimeConstraint::{{{realtime}}}}]

Zusammenfassung:
<div>
</div>
```

Below the code editor, there is a note: 'Bitte beachte, dass alle Beiträge zu AICASys von anderen Mitwirkenden bearbeitet, geändert oder gelöscht werden können. Reiche hier keine Texte ein, falls du nicht willst, dass diese ohne Einschränkung geändert werden können.'

Forms related to things and their templates

ID:
Context:
Capability:
Name:
Realtime:
Intention:
SPARQL Query:

Freitext:

Zusammenfassung:

☐ Nur Kleinigkeiten wurden verändert ☒ Diese Seite beobachten

Seite speichern
Vorschau zeigen
Änderungen zeigen
Abbrechen

```

{{Service
|id=
|context=
|capability=
|name=
|realtime=
|intention=
|query=
}}
```

Forms Definition in SMW

Formular
Diskussion
Lesen
Bearbeiten
Versionsgeschichte
Suchen

Bearbeiten von „Formular:Inventory“

Warnung: Du bist nicht angemeldet. Deine IP-Adresse wird öffentlich sichtbar, falls du Bearbeitungen durchführst. Sofern du dich [anmeldest](#) oder ein [Benutzerkonto erstellst](#), werden deine Bearbeitungen zusammen mit anderen Beiträgen deinem Benutzernamen zugeordnet.

Diese Seite kann nicht mit semantischen Annotationen versehen werden, da der Namensraum hierfür nicht konfiguriert wurde.

F
K
Ab
SA

```

{{#forminput:form=Inventory}}

</noinclude><includeonly>
<div id="wikiPreview" style="display: none; padding-bottom: 25px; margin-bottom: 25px; border-bottom: 1px solid #AAAAAA;"></div>
{{#for template|Inventory}}
{{ class="formtable"
! Name:
| {{{field|name}}}
|-
! Description:
| {{{field|description}}}
|-
! Context:
| {{{field|context}}}
|-
! Type:
| {{{field|type}}}
|-
! Room:
| {{{field|room}}}
|-
! Id:
| {{{field|id}}}
|-
! State:
| {{{field|state}}}

```

Zusammenfassung:

Bitte beachte, dass alle Beiträge zu AICASys von anderen Mitwirkenden bearbeitet, geändert oder gelöscht werden können. Reiche hier keine Texte ein, falls du nicht willst, dass diese ohne Einschränkung geändert werden können.

Du bestätigst hiermit auch, dass du diese Texte selbst geschrieben hast oder diese von einer gemeinfreien Quelle kopiert hast (weitere Einzelheiten unter [AICASys:Urheberrechte](#)). ÜBERTRAGE OHNE GENEHMIGUNG KEINE URHEBERRECHTLICH GESCHÜTZTEN INHALTE!

Seite speichern
Vorschau zeigen
Änderungen zeigen
Abbrechen | Bearbeitungshilfe (wird in einem neuen Fenster geöffnet)

Light Service Description in SMW

LightService

Inhaltsverzeichnis [\[Verbergen\]](#)

- 1 ID:
- 2 Context:
- 3 Fähigkeiten:
- 4 Service-Name:
- 5 Echtzeit-Wert:
- 6 Intention
- 7 SPARQL Query

ID: [\[Bearbeiten\]](#)

LightService

Context: [\[Bearbeiten\]](#)

<https://koralle27.fzi.de/aicasys/ontology#ServiceDescription>

Fähigkeiten: [\[Bearbeiten\]](#)

Switch Light On Capability, Switch Light Off Capability

Service-Name: [\[Bearbeiten\]](#)

LightService

Echtzeit-Wert: [\[Bearbeiten\]](#)

1000

Intention [\[Bearbeiten\]](#)

Switch Light Off Intention, Switch Light On Intention

SPARQL Query [\[Bearbeiten\]](#)

prefix rdfs: <<http://www.w3.org/2000/01/rdf-schema#>>

prefix rdf: <<http://www.w3.org/1999/02/22-rdf-syntax-ns#>>

Light Service representation in Triplestore

Explore (wiki:LightService)(1-18 of 18)

LightService

Resource:

Results per page:

Results offset:

Show data types & language tags: ☒

Subject	Predicate	Object	Context
wiki:LightService	swivt:page	wikis:LightService	
wiki:LightService	swivt:wikiNamespace	0	
wiki:LightService	swivt:wikiPageSortKey	"LightService"	
wiki:LightService	rdf:type	swivt:Subiect	
wiki:LightService	rdf:type	wiki:Kategorie-3AService	
wiki:LightService	rdf:isDefinedBy	<http://localhost:8888/aicasy/index.php/Special:RDF_exportieren/LightService>	
wiki:LightService	rdf:label	"LightService"	
wiki:LightService	wiki:Attribut-3AZuletzt_se-Ca-Aandert-3amx	2437208.3320439	
wiki:LightService	swivt:wikiPageModificationDate	2015-10-15T19:38:06Z	
wiki:LightService	wiki:Attribut-3AHasContent	<https://koralle27.fzi.de/aicasy/ontology#ServiceDescription>	
wiki:LightService	wiki:Attribut-3AHasId	wiki:LightService	
wiki:LightService	wiki:Attribut-3AHasCapability	wiki:Switch_Light_Off_Capability	
wiki:LightService	wiki:Attribut-3AHasCapability	wiki:Switch_Light_On_Capability	
wiki:LightService	wiki:Attribut-3AHasIntention	wiki:Switch_Light_Off_Intention	
wiki:LightService	wiki:Attribut-3AHasIntention	wiki:Switch_Light_On_Intention	
wiki:LightService	wiki:Attribut-3AHasName	"LightService"	
wiki:LightService	wiki:Attribut-3AHasRealtimeConstraint	1000	
wiki:LightService	wiki:Attribut-3AHasSparglQuery	<pre> prefin sdfs: <http://www.w3.org/2000/01/rdf-schema#> prefin sdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> prefin wiki: <http://localhost/aicasy/index.php/Special:URF-Auf1AC3AB6aac/> select ?instance ?intention ?rule ?action ?capability where { ?instance rdf:type wiki:Kategorie-3AService. ?instance wiki:Attribut-3AHasId wiki:LightService. ?instance wiki:Attribut-3AHasIntention ?intention. ?intention wiki:Attribut-3AHasRule ?rule. ?intention wiki:Attribut-3AHasAction ?action. ?instance wiki:Attribut-3AHasCapability ?capability. }</pre>	

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A Lamp description in SMW

Lamp1

Inhaltsverzeichnis [Anzeigen]	
Inventar Name: [Bearbeiten]	== Inventar Name: == [[HasName::{{{name }}}]]
Lamp1	
Beschreibung: [Bearbeiten]	== Beschreibung: == [[HasDescription::{{{description }}}]]
Lamp1 is standard-lamp which is standing next to table on the Wohnzimmer	
URI der Typbeschreibung: [Bearbeiten]	== URI der Typbeschreibung: == [[HasContext::{{{context }}}]]
https://koralle27.fzi.de/aicasys/ontology#Lamp	
Inventar Typ: [Bearbeiten]	== Inventar Typ: == [[IsOfType::{{{type }}}]]
Lamp	
Raum: [Bearbeiten]	== Raum: == [[IsInRoom::{{{room }}}]]
Wohnzimmer	
URI: [Bearbeiten]	== URI: == [[HasId::{{{id }}}]]
Lamp1	
Mögliche Zustände: [Bearbeiten]	== Mögliche Zustände: == [[#arraymap::{{{state }}} , x [[HasState::x]]]]
on, off	
Funktionen: [Bearbeiten]	== Funktionen: == [[#arraymap::{{{functionality }}} , x [[HasFunctionality::x]]]]
Switch Light on, Switch Light off	
Kategorien: Inventory Lamp	[[Kategorie:Inventory]] [[Kategorie::{{{type }}}]]

SMW data representation in triplestore

Workbench

Sesame server

Repositories

New repository

Delete repository

Explore

Summary

Namespaces

Contexts

Types

Explore

Query

Saved Queries

Export

Modify

SPARQL Update

Add

Remove

Clear

System

Information

OpenRDF

Current Selections:
Sesame server: <http://localhost:8080/openrdf-sesame> [change](#)
Repository: [AICASys \(aicasys\)](#) [change](#)
User (optional): [none](#) [change](#)

Explore (wiki:Lamp1)(1-21 of 21)

Lamp1

Resource:

Results per page:

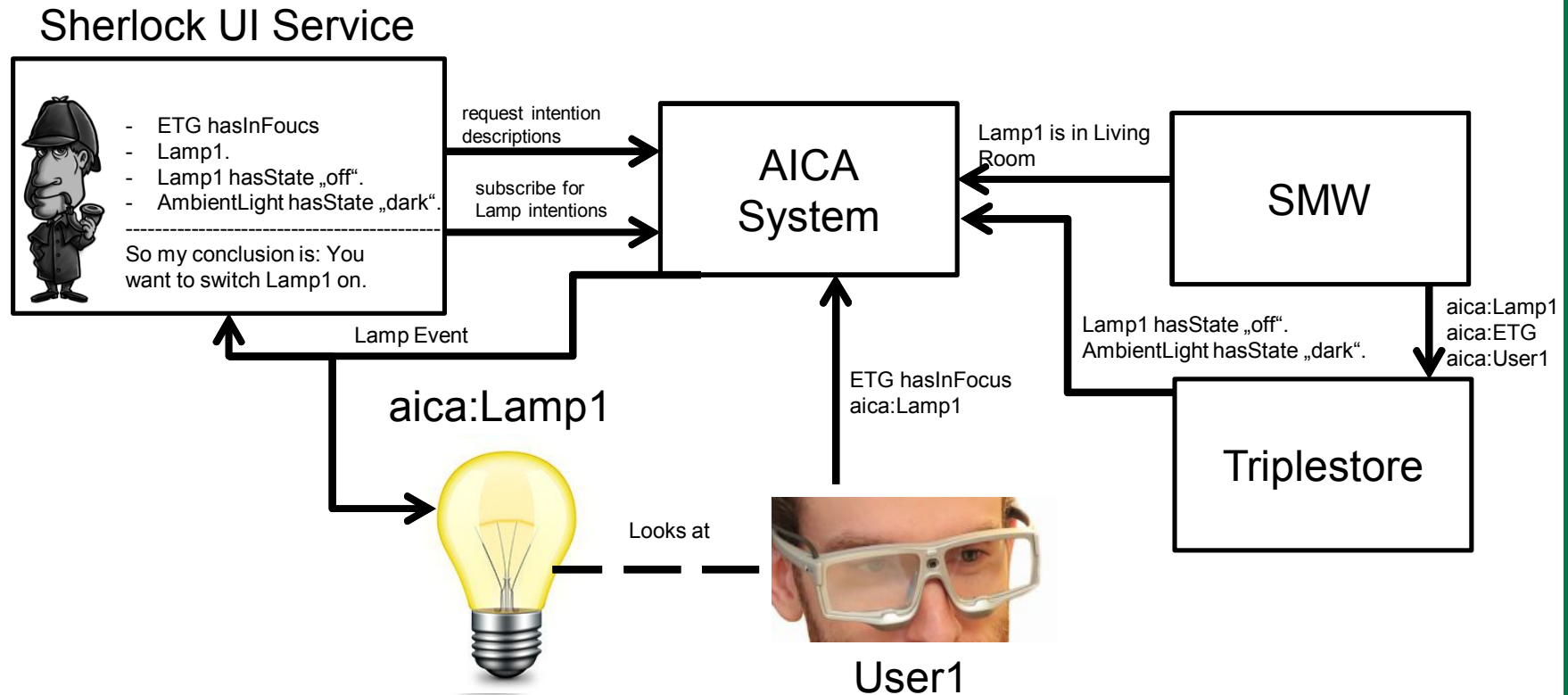
Results offset:

Show data types & language tags: ☒

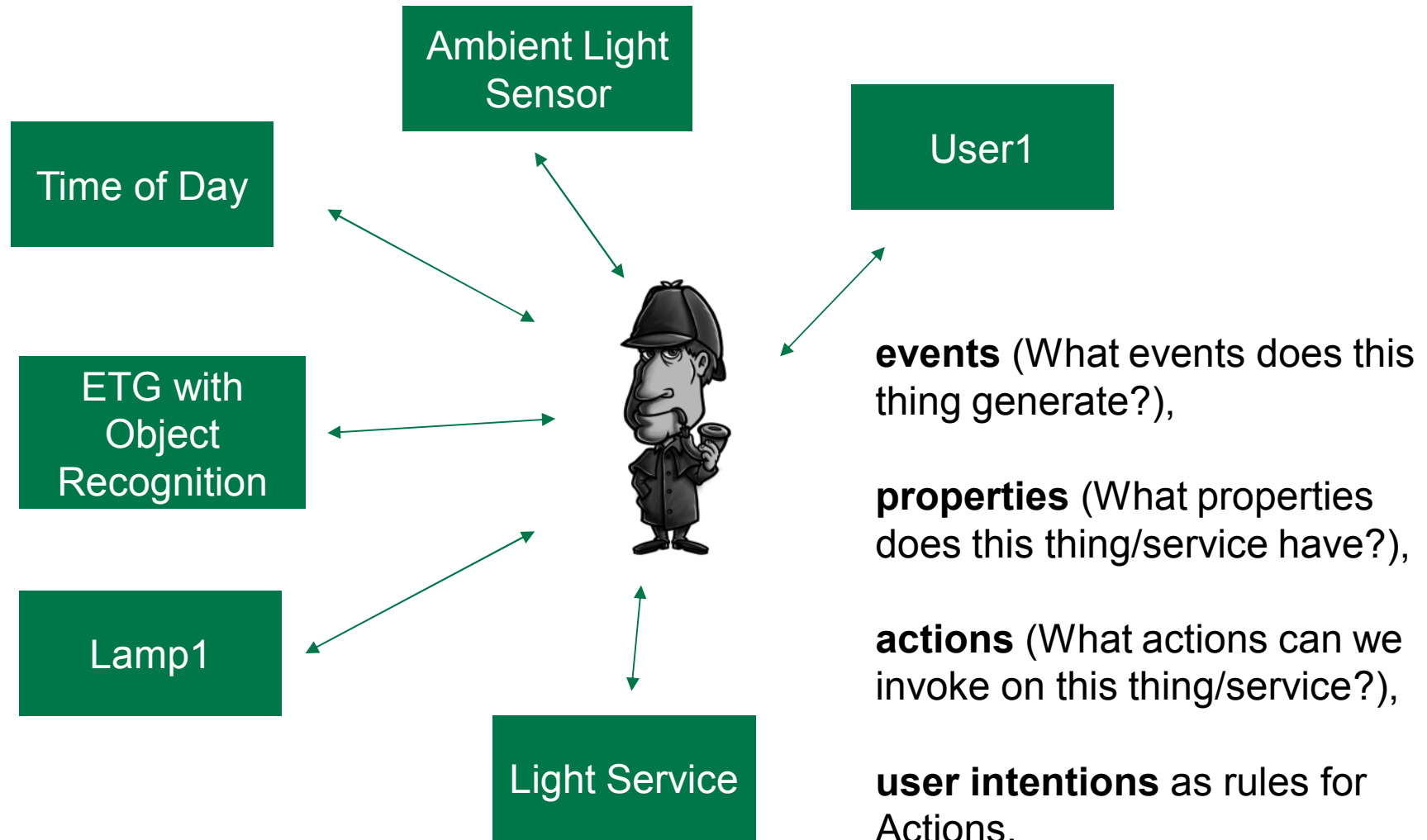
Subject	Predicate	Object	Context
wiki:Lamp1	swivt:page	wikiurl:Lamp1	
wiki:Lamp1	swivt:wikiNamespace	0	
wiki:Lamp1	swivt:wikiPageSortKey	"Lamp1"	
wiki:Lamp1	rdft:type	swivt:Subject	
wiki:Lamp1	rdft:type	wiki:Kategorie-3ALamp	
wiki:Lamp1	rdft:type	wiki:Kategorie-3AInventory	
wiki:Lamp1	rdft:isDefinedBy	<http://localhost:8888/aicasys/index.php/Special:PDF_exportieren/Lamp1>	
wiki:Lamp1	rdft:label	"Lamp1"	
wiki:Lamp1	wiki:Attribut-3AZuletzt_re-C3-Aandert-3Aaus	2457:00:28:07:87	
wiki:Lamp1	swivt:wikiPageModificationDate	2015-10-04T18:47:38Z	
wiki:Lamp1	wiki:Attribut-3AHasContext	<https://koralle27.fzi.de/aicasys/ontology#Lamp1>	
wiki:Lamp1	wiki:Attribut-3AHasDescription	"Lamp1 is standard-lamp which is standing next to table on the Wohnzimmer"	
wiki:Lamp1	wiki:Attribut-3AHasFunctionality	wiki:Switch Light off	
wiki:Lamp1	wiki:Attribut-3AHasFunctionality	wiki:Switch Light on	
wiki:Lamp1	wiki:Attribut-3AHasId	wiki:Lamp1	
wiki:Lamp1	wiki:Attribut-3AHasState	"on"	
wiki:Lamp1	wiki:Attribut-3AHasState	"off"	
wiki:Lamp1	wiki:Attribut-3AIsInRoom	wiki:Wohnzimmer	
wiki:Lamp1	wiki:Attribut-3AIsOfType	"Lamp"	
wiki:Lamp1	wiki:Attribut-3AHasName	"Lamp1"	
wiki:Wohnzimmer	wiki:Attribut-3AHasInventory	wiki:Lamp1	

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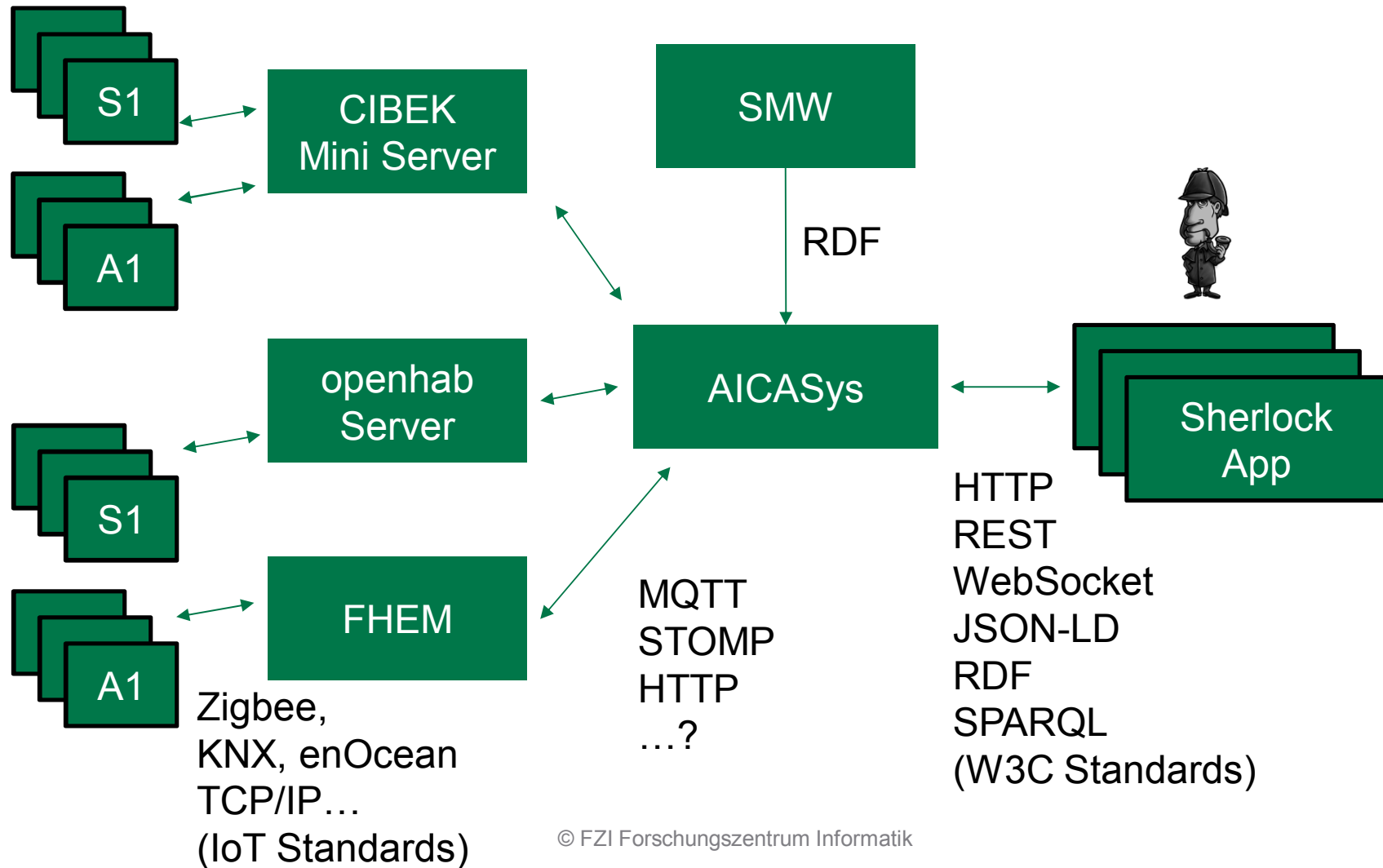
Example Use Case: Sherlock UI Service



Conceptual Perspective

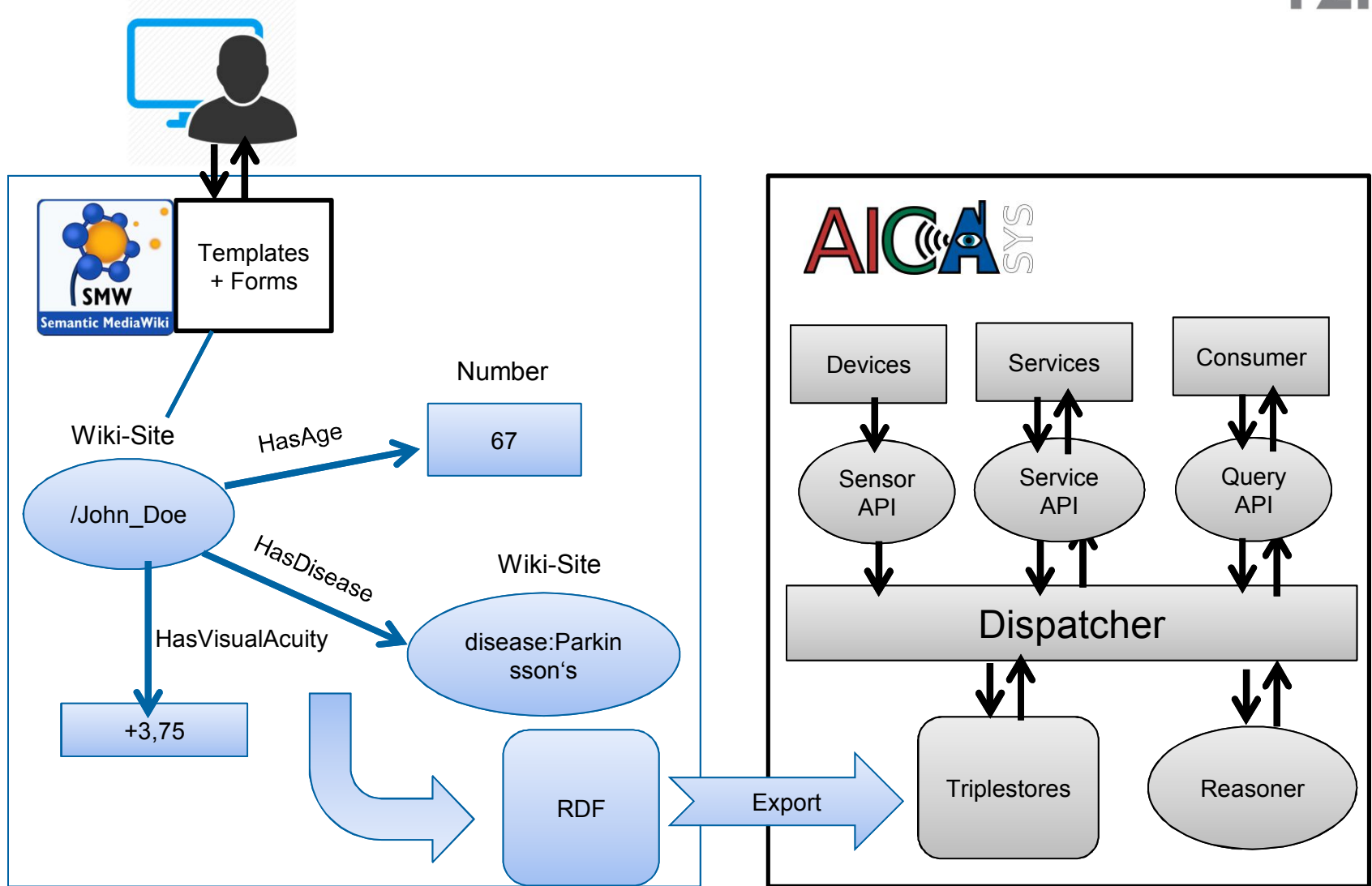


Technical Perspective



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Example: User Profile Mapping to SMW



Advantages of RDF Export in SMW

Applied to Sesame Triplestore

- SMW RDF Export configuration in LocalSettings.php just a few lines of code:

```
▪ $smwgDefaultStore = 'SMWSparqlStore';$smwgSparqlDatabaseConnector = 'sesame';  
▪ $smwgSparqlQueryEndpoint = 'http://localhost:8080/openrdf-sesame/repositories/aicasys';  
▪ $smwgSparqlUpdateEndpoint = 'http://localhost:8080/openrdf-sesame/repositories/aicasys/statements';  
▪ $smwgSparqlDataEndpoint = " ;#  
▪ $smwgSparqlDefaultGraph = " ;
```

- Synchronization with triplestore immediately after user clicked save button in SMW.
- Forms and Templates structure the thing description.
- Also not technically minded persons can create new things in SMW.

That's it – Thanks for your attention

